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ABSTRACT

Arranged in three sections, this resource for secondary school students provides an introduction to the computer's impact on society. The first section surveys historical methods of recording and storing information: clay tablets, papyrus, and books. The second section describes how computers work and ways they can be used. Also considered are the effects of computer technology on medicine, space travel, shopping, traffic control, and money. The final section discusses some of computer technology's potential problems, such as invasion of privacy, depersonalization, development of a police state, computer crime, and a machine-controlled society. A glossary of computer terms is included. (LP)

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The Computer and Society

Our Servant - Our Master?

A Unit of the Social Education Materials Project 'People and Change'.

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Introduction

The Computer and Society is intended to give you an introduction to the computer, an invention that has had a great effect on our way of life. It is not a text book concerned with the technical details of programming computers. This book attempts to look at the impact of these machines on our society, and any problems that they may cause.

There has been a long argument as to whether computers are a potential evil in our society. Supporters of computers are firm in their belief that the computer can be a valuable servant of man, and help him solve some of his pressing social problems. Critics of the computer, on the other hand, view the computer as a dangerous machine, with the potential to control man.

Hopefully this book will illustrate some of these points of view, and will help you to make up your mind as to whether the computer is our servant or our master.

The book is divided into three sections:

A **The Information Explosion**

A brief survey of the methods used previously to record and store information, and the difficulties involved as our sum of knowledge increases.

B **What is the Computer?**

A basic survey of the computer and how it works, and a few examples of how the computer can be used.

C **The Impact of the Computer in Society**

A review of some of the social effects of the computer.

A glossary of computer terms is also included.

A. The Information Explosion

One of the most striking features of life today is the vast amount of information available. No matter what your interest may be, there is a great deal of detailed information easily available. The amount of knowledge available today is staggering, especially when we look at the past.

In Europe before 1500 A.D., only about 1,000 books were produced in a year. At that rate it would take 100 years to fill one of today's average sized libraries. By the 1960's the rate of production of books had increased so much that over 100,000 books were being produced every 6-8 months. By the mid 1970's over 1,000 new books were being printed every single day.

This vast amount of available information can cause problems of storage and recovery. Scientists may spend large amounts of time and money on problems to which, unknown to them, answers have already been found and published. In 1970, for example, the U.S. Patent Office held over 8.5 million patents - imagine the task of checking all these by hand!

One answer to this problem may be to have more, and larger libraries. But the vast amount of material being produced raises several important questions:

- A greater production of books is going to mean more pressure on the world's timber resources. Are there enough trees in the world to keep pace with this continued increase?
- Libraries can expand to meet this 'information explosion' but is there a limit as to how large they can become? One recently built library in Australia, for example, had to be strengthened because no one had taken into account the weight of the ¼ million books the library was supposed to contain.
- As libraries become bigger will they tend to become impersonal and even frightening? A large library with signs everywhere, and row upon row of shelves may appear a rather daunting place.
- Will the use of an increasingly complicated catalogue card system in a library be confusing to some people? Might such confusion make people less confident about using the library?
- Some libraries have tried to overcome the problem of storing large numbers of books by using microfilm or microfiche on which to record information. These methods are very valuable, but might some people feel unsure about using them?

The problem of gathering, storing and recovering information is not

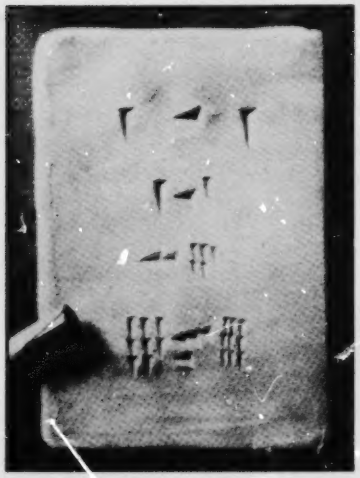
a new one. There were problems in the past in trying to record information. Some of the methods used seem primitive and slow by today's standards, but suited the times in which they were used.

Clay Tablets

The recording and storing of information on clay tablets is very ancient. Around 3000 BC the people of **Sumer** were among the world's first users of clay tablets for writing and recording purposes. We know this to be a fact through the work of archaeologists who have found numerous clay tablets in the ruins of Sumerian cities.

The Sumerians enjoyed quite a high level of civilization with a well developed agricultural and trading economy. The need for a way of recording food production and trading details was soon obvious. A way of preserving this information for lengthy periods of time, from one season to the next for example, was also considered desirable. A soft **clay tablet** provided the answer.

Once a bed of soft clay had been prepared, a Sumerian scribe would use a hard, wedge shaped writing stick to imprint his marks into the clay. Different combinations of these wedge shapes were used to write down the words that were the language of the people. Today we call this form of writing **cuneiform**. The name is taken from the Latin word **cuneus** which means **wedge**.



An example of cuneiform writing.
The piece of wood with the angled corner is the cuneus which is used to make these wedge-shaped numerals.
The top line represents the cuneiform numerals (from left - right) 1, 10, 60.
Using this system the second line represents 71. Can you work out what numbers lines three and four represent?
(Answer at bottom of page.)

Once a tablet had been filled with words, it was then baked hard in the sun or in an oven. This record was thus preserved for as long as the clay tablet lasted. So successful was this method of permanently storing information that we still have ancient clay tablets which have survived up to the present day.

Translation of cuneiform writing was very difficult. It was not until a code was discovered in Persia in the 19th Century that modern man was able to understand this ancient language. It was only then that we discovered that all business transactions and records, personal and official letters and even school work, was done on the earliest form of recording information, the clay tablet.

Papyrus

In ancient Egypt a totally different surface for the recording of information was developed. Growing in marshes and along the banks of the River Nile were vast quantities of **papyrus** reed. This reed, which grew to a height of 4 metres, provided a thin paper-like writing surface, and it is from this reed that our word 'paper' is derived.

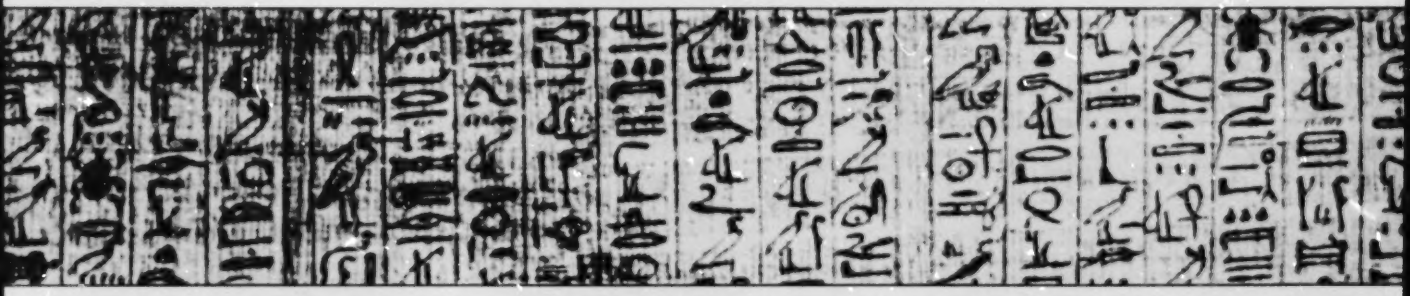
Once cut, the papyrus reed was peeled and split into strips. These strips were soaked and repeatedly pounded with a flat stone until the

Line three represents 25, line four 529.

required thin paper-like sheet was produced.

When dried, the papyrus sheets were written on with pens carved from reed stems. For ink, a mixture of vegetable gum, soot and water was used.

Like the Sumerians, the Egyptians had their own language and style of writing. Egyptian **hieroglyphics** proved impossible to translate until



the discovery of the **Rosetta Stone**. In 1799, explorers working in the small Egyptian town of Rosetta, on one of the mouths of the Nile, discovered a tablet of black basalt rock on which the same body of information was written in three languages, Egyptian Hieroglyphics, a more modern Egyptian language and Greek. Because of the clues provided by the Greek translation, the ancient hieroglyphic code was able to be broken.

The Egyptian hieroglyphic writing was based on pictures and symbols which represented each word.

The First Books

The first books, as we know them, were written by hand. Monasteries were among the first producers of books, not only copies of the bible, but also the first books of learning. Here skilled monks would labour for years to produce the elaborately intricate handwriting found in these books.

But gradually, throughout the world, inventions were taking place that would revolutionize the recording and storing of information. The Chinese invented the manufacture of paper in the first century, while medieval monks learned primitive printing techniques using carved wooden blocks.

Mass production of handwritten books was attempted in the 1400's but with limited success. A rich Italian noble employed forty-five scriveners to produce manuscripts for his private library. In two years of exacting work, only 200 books could be produced.

But it has been credited to **Johannes Gutenberg** of Mainz, Germany with having combined all the accumulated printing knowledge of the time into one of the most important machines ever devised - the movable type printing press. With this invention it was now possible to mass produce the world's knowledge, thus making it more widely available for many more people. In one day, using the Gutenberg press, one man could turn out 300 pages. The revolution in man's ability to store, and easily retrieve, knowledge, had commenced.

With the invention of the computer in the 20th Century has come the most efficient means of collecting, storing and retrieving information yet devised.

The great speed at which a computer works, together with its accuracy and reliability, has meant that we are better able to control this information explosion. Yet at the very same time the computer is responsible for contributing to the most rapid growth in information and knowledge the world has ever known.

B. What Is A Computer?

The world's first computer, the **abacus**, appeared in the Near East and China about 2000 years ago. It is one of those rare inventions that are so simple yet so effective that they pass unchanged from civilization to civilization.

The abacus is really a refinement of man's first system of arithmetic, pebble counting. Beads which slide along a wire are substituted for the pebbles, and represent units, tens, hundreds, etc. as in decimal arithmetic. The abacus is very simple and speedy, and even today still has wide acceptance. It is claimed that merchants in Hong Kong are more accurate and as quick as someone using an electronic calculator.

Computing machines have a long history of development. From evidence gained after an undersea archaeological find in 1900, it is believed that the ancient Greeks had developed a mechanical, geared, computer which dates back over 2000 years.

Today calculators, of differing degrees of complexity, fill our museums. In 1642 a Frenchman, **Blaise Pascal**, invented an intricate adding and subtracting machine. In the 19th century **Charles Babbage**, an English inventor, designed a machine to calculate mathematical tables. In theory this elaborate machine would have worked. It failed to operate effectively only because the technology of the time was not sufficiently advanced to be able to manufacture the intricate parts accurately.

In 1930 Dr Vannevar Bush, an American, built what was probably the last, and largest, mechanical computer. Used during World War II to calculate artillery trajectories, its mechanical gears and metal shafts were soon to be replaced by electronic parts.

By 1946 the first electronic computer capable of additions in 1/5000 of a second was built at the University of Pennsylvania. Today's larger computers can complete the same calculation in 1.5 millionths of a second. The effect that the development of highly sophisticated electronic computers has had on science and our way of life is substantial, and has been felt in many different ways:

Predicting Election Results:

- In the Federal elections held in Australia in December 1977, computers had accurately forecast the results only an hour after the counting of votes started.

Preparing Bank Statements:

- Computers have greatly helped modern banks; a medium-sized computer can prepare 10,000 bank cheques in 10 seconds.

Guiding Astronauts in Space:

- The American moon programme (APOLLO) involved

scientists in millions of calculations. To work this out with pencil and paper would take centuries. The moon flight calculations were made by electronic computers both at ground control centres and on the space ships themselves.

Preventing Crime and Catching Criminals:

- Police forces in the major states of Australia use computers to help them in their fight against crime. These computers contain information on stolen vehicles, and details on criminals and suspects. Such details as height, weight, nicknames, aliases, previous record and known associates are all quickly available to the police.

- A policeman on the beat can radio his base about a suspected stolen car, and receive an answer from the computer within minutes as to whether or not the car is stolen.

Because the computer can carry out these and many other tasks, many people think of the computer as a magic machine, capable of electronic miracles. Like the washing machine in your laundry, the computer is only a piece of electronic equipment.

A computer is simply a calculating device - that is, it can work out something. It handles information given to it called **data**. The specific data given to the computer is called a **program**, and the person who prepares this data is called a **computer programmer**.

The program of a computer is similar in some ways to a washing machine. Most modern automatic washing machines have various cycles. Dainty, delicate items can be washed in the gentle, cold water cycle, and dirty, greasy overalls in the heavy duty, hot water cycle. There may be as many as 8 cycles to choose from. These cycles are no more than programs for your washing machine.

In the same way the computer programmer instructs his machine to add, subtract, divide, multiply, and perform dozens of other actions in any order to solve any problems. A combination of these instructions form a program.

The internal storage of information and instructions is called the computer **memory**. Data is read into the memory from punched cards or magnetic tape. Other means include marked cards, paper tape, a light pen or magnetic ink.

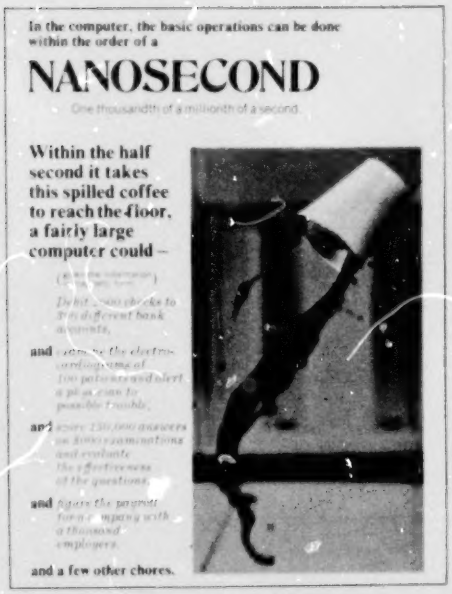
The program will tell the computer to do precisely what you want it to do, but if a mistake or an omission is made in the program, then the computer will make errors or produce seemingly confused information.

There was a recent example of a woman in Sydney who received a bill for $00.00 from a large department store. She received several threatening letters before she sent a cheque for $00.00. This error was not the fault of the computer. The computer programmer had failed to give the computer the correct instructions to avoid this silly mistake.

But if an adding machine or a calculator can be used to add, subtract, divide and multiply, then why is a computer so special? There are several reasons:

Speed

The computer's lightning speed makes it possible to tackle problems that are so large as to make them impossible the pen and paper way. Calculators can be used to make the arithmetic task much easier, but they are limited in their capacity, as they require a separate operation for each step.


In the computer, the basic operations can be done within the order of a
NANOSECOND
One thousandth of a millionth of a second.
Within the half second it takes this spilled coffee to reach the floor, a fairly large computer could –
and
and
and a few other chores.

To demonstrate the speed of a computer, let's take an example.

Using only a pencil and paper (not a calculator) work out how long it would take you to multiply these two 10-digit numbers, 7456323715 x 9807574243. Supposing it takes you 10 minutes, then working 24 hours a day for 365 days, you could do 52,560 similar multiplications in one year. In a hundred years, working at the same rate, you could do 5,265,000 multiplications. The fastest computers today can do almost **twice** as many such calculations in **one second** without an error.

Computers work 400 million times faster than man's brain.

Accuracy and Reliability

Parents know how hard it is to balance a cheque account or to work out income tax. A computer can balance 10,000 cheque accounts in 10 seconds without error, and perform it repeatedly hour after hour.

Versatility

A computer can do much more than perform mathematical operations quickly and accurately. A computer, by using programmed instructions, can sort date, straighten data out, and then store it away for future use. Programmed instructions enable a computer to arrange a list of numbers, or names, in one given order into another list in another order. For example, a computer at a school could produce a list of all 15-year old boys in Blue House in order to assist the sports teacher in preparing the annual swimming carnival.

Memory Capacity

A computer can store immense files of information to which it can gain access in fractions of a second, seconds, or, at worst, in minutes. The memory capacity of humans is extremely limited by comparison. Many students would have had the experience of completely forgetting all the information learned for an examination as soon as they entered the examination room. Once data is given to the computer it is stored in the memory until needed or removed. It is never forgotten, but can, of course, be erased.

How Does a Computer Work?

To help us understand how a computer works let us look at a typical desk job in an office. A clerk in an office will have the use of the following items -

In Tray:

This lets the clerk know what tasks are to be performed and in what order they should be done. This tray can be described as an **input device**.

Calculating Machine, Pen and Paper:

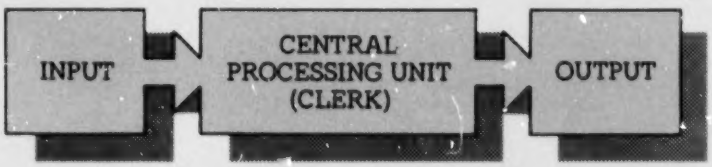
The clerk uses these items to work on or **process** the information or

data taken from the in-tray. Collectively they are referred to as the **central processing unit** (CPU). The clerk is able to use his own intelligence and memory to assist him to make any decisions as to which data to deal with and when. But he is subject to those human failings, tiredness, illness or boredom, which can reduce the amount of work he can do, and increase his chances of making a wrong decision.

Out Tray:

This lets other people in the office know what work has been completed. This out tray is an **output device**.

The action of processing information at the desk can be seen by this diagram where the arrows indicate the direction of flow of the information.



The computer goes through the same basic procedure described in the office. It, however, performs these tasks by means of electronic components. The computer is able to process information very quickly, and, unlike the office clerk, is not affected by tiredness, boredom or sickness. It can perform repeated calculations for a long period of time without error.

The computer has five major components:

The **input** puts information (program and data) into the machine.

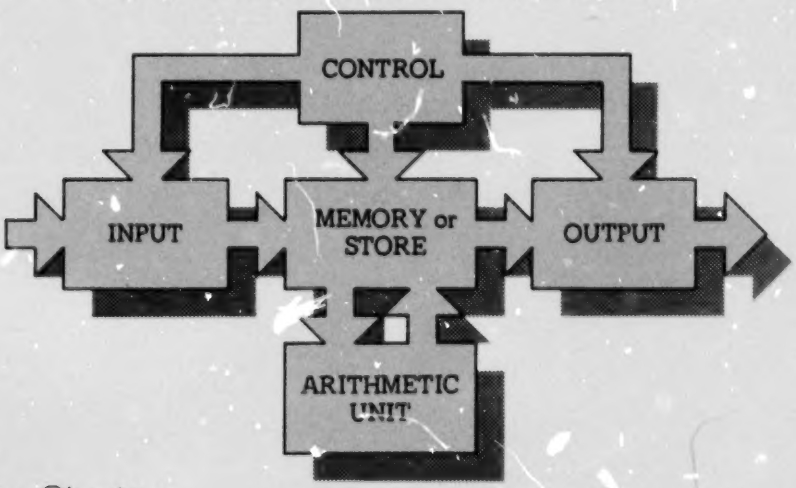
The **memory** stores information and makes it available when required.

The **arithmetic unit** performs the necessary calculations.

The **output** feeds information out of the machine.

The **control** enables the computer's components to function in the proper order.

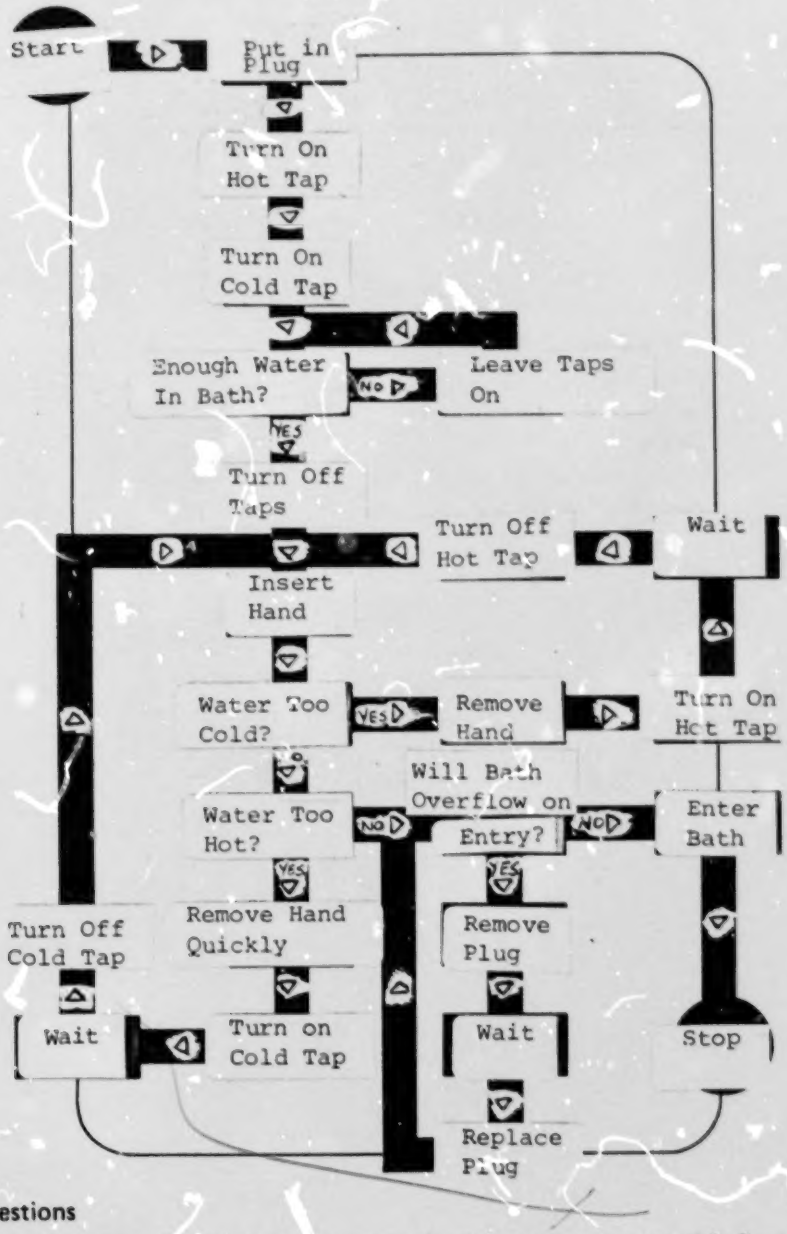
A diagram of the computer's activities may look something like this.



Flow Charts

If a computer was to be programmed to perform a simple task such as running a bath, the first step would be to produce a flow chart, such as in

the example below. This flow chart is used as the basis for writing the program. Actions are shown in grey boxes, and decisions in green boxes.



Questions

(i) Can you think of any other possible steps to add to this flow chart?

(ii) What would happen if one of the steps mentioned in the flow chart was to be removed?

(iii) Which step would cause the most confusion if it was removed?

(iv) Draw up your own flow charts for some simple programs. Some suggestions which you may consider are -

Making a cup of tea.
Cleaning your teeth.
Kissing your girlfriend/boyfriend goodnight.

Misconceptions About Computers

Computers can think

A computer cannot think - any more than a washing machine can. What it does is extend man's problem-solving capabilities by performing instructions with lightning speed.

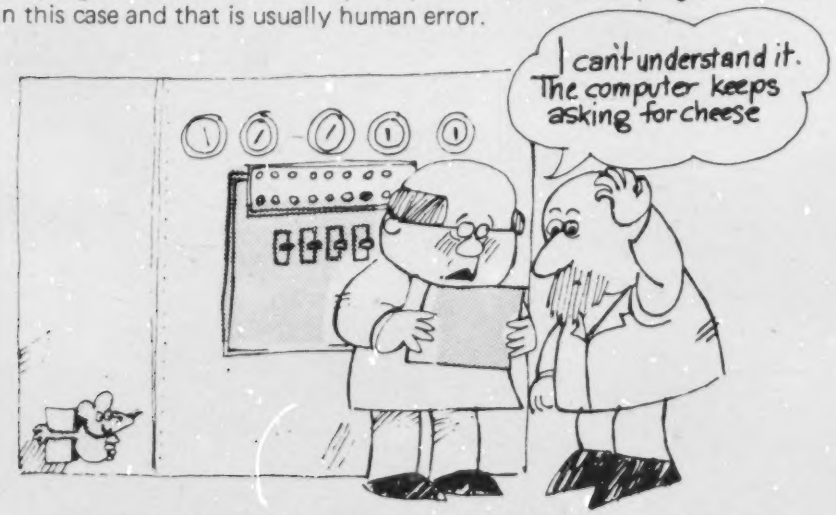
For example the computer does not decide election results. It merely presents the results of a carefully written program, based on available figures, that calculates the possible election result. Hence the election forecast of two computers may vary. The computers do not disagree, but rather it's the people who wrote the programs for the computers who disagree.

Computers have a brain

The computer does not have a brain of its own. It can only solve problems which it has been programmed to deal with. It cannot discover new ways of solving problems.

Computers are infallible

We hear a lot about the so-called 'failures' of computers. Take the case of the computer that printed a pay cheque for $1,250,000 instead of $125, the correct amount. Obviously here was an example where the program had not been completely checked. It was a 'program failure' in this case and that is usually human error.



The launching of Mariner 1, an American rocket bound for Venus, involved hundreds of programmers writing many programs, each containing thousands of steps. Despite numerous test runs an undetected error or bug disabled the $18.5 million rocket, so that it had to be destroyed five minutes after take-off from Florida. Again, the programmers failed.

This is not to say the computer never fails. After all, like the washing machine, it generally lets you know when it fails. It does not take you 28 loads of wash to discover the spin cycle is not working in your machine. In a similar way, when a computer has a failure, it can usually be spotted quickly.

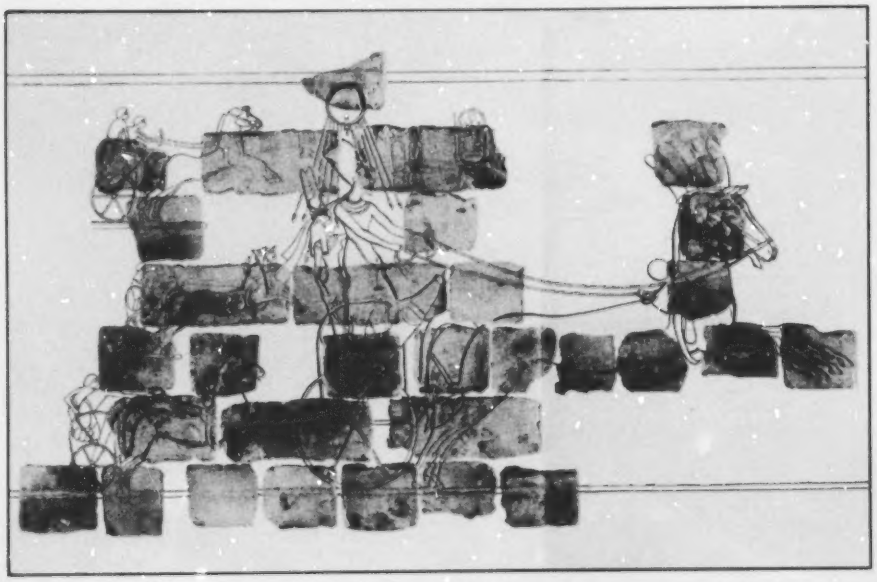
Applications of the Computer

The following examples may give you some indication of the application of the computer.

1 The World's Largest Jigsaw Puzzle

Thirty-three centuries ago, the Pharaoh **Akhenaten**, the father-in-law of Tutankhamen, built a massive temple to the god Aten near the banks of the Nile. It lasted only for 20 years, before it was pulled down by Akhenaten's successor who worshipped another god.

The stone blocks used in the temple were 60 cms long, 25 cms wide and 25 cms deep. In the 1920's, an expedition uncovered some 35,000 of these sandstone blocks, decorated on one side. The size and number of these blocks made it impossible for the archaeologist to solve this ancient "jigsaw puzzle".



Another expedition in the late 1960's adopted a new approach. They photographed the relief carved faces of these blocks, numbered the photographs, and from these photographs, every available detail - colour of paint, sex, size and other features of the figures, angles of sunrays, hieroglyphics - was fed into a computer in Cairo, which in turn prepared listings of stones with related characteristics.

When the archaeologists came to recreate pictorially the temple, and say, came to a block with Akhenaten's right leg on it, all they had to do was to consult the computer list of all blocks with figures of Akhenaten in proper scale, and match the appropriate numbers on the photographs.

The archaeologists and artists then combined to produce paintings showing what the temple looked like, especially a magnificent pillared courtyard honouring Akhenaten's queen, **Nefertiti**. Thus the computer and the archaeologists were able to solve the world's oldest, and biggest, jigsaw puzzle.

2 The Computer and Medicine

A full-size, life-like plastic-skinned model known as Sim One - for simulated patient No 1 - has been developed in the United States of America, for use as a guinea pig by medical students. Powered by a computer, Sim reacts to their experiments by sleeping, coughing, vomiting, changing his breathing rate, and even temporarily dying. Doctors and instructors can vary Sim's reactions, and keep a close check on the performance of their students.

Other ways in which computers have been used in hospitals include

Sim One in action.

the checking of the patients in intensive care wards using an electro-cardiograph to record their heart beats, the making of nurses' rosters, the booking and arranging of rooms for patients, and the preparation of hospital bills.

A computer at the Kansas City Hospital in the United States has been able to help save the lives of young children who may poison themselves accidentally. Details of the effects and actions of some 5,000 household substances and poisons are recorded on this computer. If a child accidentally takes some poisonous substance, the computer can tell quickly what symptoms to expect, suggest antidotes and advise treatment.

3 The Computer and Space Travel

Computers have played a special part in the United States space program. When the Apollo 13 rocket was on its way to the moon an oxygen tank exploded. This left the three astronauts with only their small moon landing rocket to get them back to earth.

The entire mission had to be replanned at very short notice. The computers at the Apollo headquarters in Houston were able to work out all the calculations required, and radio these to the astronauts. They carried out the instructions as the computer suggested. The result - a successful splash down!

4 The Computer and Shopping

The following examples may give you some idea how computers have been used to help business.

- Consider a big take-away food chain, with a number of branches in the city. When you buy a hamburger, the salesgirl presses a key with the appropriate code and price. Her punching is automatically recorded by the computer. The next day the computer pulls in all the data stored the previous day. The computer adds the number of hamburgers sold the day before in all the shops. It subtracts that number from the number of hamburgers in the supply centre. It compares the result with the number of hamburgers estimated to be needed for today, and prints an order for the right number of hamburgers to be brought to the supply centre. The computer also prints a list of how many hamburgers are to be sent to each shop.

- When a woman buys a dress in a dress shop, the salesgirl tears off a portion of the price ticket that has a mass of holes in it. That night many such stubs go through a reading machine which transforms the data on the stubs into holes in punch cards ready for the computer. The next morning the dress buyer receives a report from all the stores branches showing just what dress styles were selling best. This enables new stock to be ordered.

Perhaps development of the computer may reach a stage where it is possible for the housewife to do her shopping by computer. It may even reach the stage shown in this next example:

Conversation With a Computer

Customer: Hello.

Computer: Good morning, Mrs Brown. What service do you require?

11 Banker	13 Doctor	15 Mechanic
12 Shopkeeper	14 Travel agent	

Customer: 12.

Computer: Shopkeeper here, Mrs Brown. Do you require

31 Groceries	33 Hardware
32 Clothing	34 Pharmacy

Customer: 31.

Computer: Thank you. Please list the groceries you require.

Customer: 1 packet cornflakes 1 tin baked beans
2 tins sardunes 1 small jar caviar
2 lb sugar

Computer: Is that all?

Customer: Yes.

Computer: Thank you. I have some queries, Mrs Brown. Large or small packet of cornflakes?

Customer: Large.

Computer: Thank you. I do not understand sardunes. Is it correct and available from grocers?

Customer: No. Sardines.

Computer: Thank you. I do not understand caviar. Is it correct and available from grocers?

Customer: Yes.

Computer: Thank you. I shall enter a special order but I cannot quote you a price. Your order needs:

1 large packet cornflakes
2 tins sardines
2 lb sugar
1 tin baked beans

Total price $01.73.

Your special order needs:

1 small jar caviar.

As the price is less than $5.00 we cannot deliver. When will you collect?

Customer: 4 o'clock.

Computer: Your order will be ready for collection at 4 p.m. at 10 High Street. Anything else just now Mrs Brown?

Customer: I have a sore throat.

Computer: I do not understand sore throat. Is it correct and available from grocers?

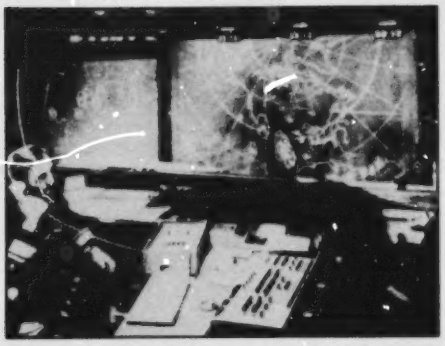
Customer: No. 13.

Computer: Doctor here Mrs Brown. What seems to be the trouble?

(Penguin 'Connexions, Living Tomorrow- Planning for the Future'. Edited by Nigel Calder. p. 16)

5 The Computer and Defence

Many countries today use the computer as an essential part of their defence system. Perhaps the best example is the United States of America which has developed an early warning system, using a combination of radar and computers.



The greatest fear that the USA has is of a rocket attack from the Soviet Union. In response to this fear a series of radar stations was built along the northern coast of Alaska and Canada. Any missile launched by the Russians is picked up by the radar and transmitted to the computers, which determine (in less than a minute) whether the rocket launched is a peaceful satellite or damgerous missile. This early earning system gives the USA warning in case of attack, and the USA has enough time to send off their missiles and planes in reply.

6 Computer Dating

Jack and Jill
Went up the hill
With great anticipating
Jack came down
And with a frown
Gave up computer dating

Edward Conti

In most newspapers today you can see advertisements for computer dating, most of them promising to match you up with a perfect or near perfect partner. Each person fills in a large questionnaire, giving details about themselves and their likes and dislikes. This information is fed into a computer and your character and interests are matched with someone of the opposite sex and you are given an introduction. The rest is up to you!

Remember - one boy got his sister as a date from a computer dating agency.

7 Can The Computer Save Venice?

Most people know the tourist image of Venice - the old buildings, the canals and the gondolas. But something very serious is happening to Venice, for this 1500 year old city is slowly dying.

Venice, which is situated on a lagoon at the head of the Adriatic Sea, faces two main problems. The city is frequently flooded (up to 70 times a year) by high tides that sweep in across the lagoon from the Adriatic. These high tides are so severe that no-one lives on the lower floor in most of the old buildings along the city's 180 canals. The outside of the walls are marked with a green slime that indicates

the high water mark.

As well as this problem of high tides, Venice is also slowly sinking. The soil of Venice consists of mud and clay, and most of the buildings rest on wooden piles driven through the mud down to the clay. This problem only increases the danger from flooding, because as the city sinks slowly it is at more danger from a high tide.

Scientists concerned for the future of Venice are using a computer to help them save the city. The computer has been used to help forecast storms in the Adriatic Sea. Hopefully these forecasts will give the scientists enough warning time to take action to reduce the effects of the high tides caused by these storms.

Here we have an example of a new scientific development being used to help save an old and beautiful city.

8 The Computer and Traffic Control

People who live in large cities know of the problems of commuting, for most people have been caught in a traffic jam at some time.

Major roadways in cities are crossed by a number of other roadways, both major and minor. Each intersection is normally controlled by a set of traffic lights, and these lights are set to change on what is called a "fixed-time" basis. This means that while the green light on the major road might be set for (say) 40 seconds, it is only set for (say) 15 seconds on the minor road.

This situation causes several problems:

- The traffic on one roadway may be held up even if there is no traffic on the cross-street. Why stop the vehicles on a heavily used major highway if there are no other vehicles waiting to cross over?
- A traffic jam may quickly form behind a smash or a breakdown on a busy main road. Many drivers, seeing the jam up ahead, turn off along bypass roads. But they then end up in another jam, for the traffic lights on these bypass roads are not set to handle so many vehicles. The traffic jams go on spreading as the traffic lights continue to change on their "fixed-time" pattern.
- Policemen cannot be used to properly control each intersection, because there are many hundreds of such intersections in the central city areas alone, and hundreds of policemen cannot be spared for this duty every day.

Computers are now being used to help solve the traffic problems of the great cities of the world. Many different computer systems have been tried but the system now being used in Sydney is generally thought to be the most advanced. Sydney, in fact, leads the world in computer traffic control.

Electronic sensing devices, called "loops", are placed underneath the roadway at each intersection. The traffic on a busy street is not stopped by the lights until the loops inform a central computer that traffic is beginning to pack up behind the lights on a cross street. The computer changes the lights just long enough for this traffic to cross and then quickly releases the traffic on the busy road.

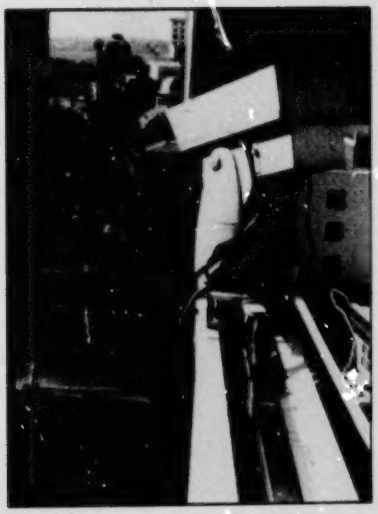
The computer receives information from each intersection in the city and is able to connect them up into one moving picture. It holds back the traffic at some lights if it can see that a jam would form if the traffic was released too quickly, or all at once.

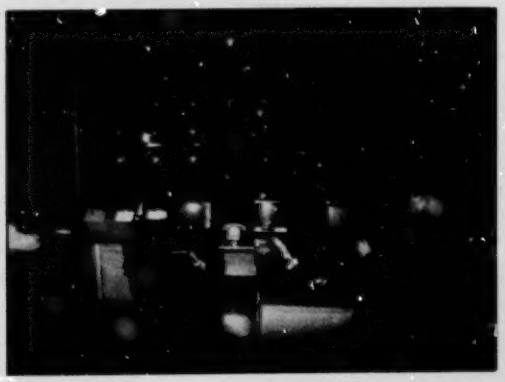
The computer is also able to control the situation if an accident occurs, for by controlling the lights it can ease the traffic flow so that other

jams do not occur.

One system being developed for the future is that the computer will actually be able to fully control all the traffic when an accident occurs. Electronic display boards at each major intersection will tell the driver what is happening up ahead, and instructions will also be sent out over all the car radios.

Another development is for the computer to be kept informed of the number of people waiting to cross an intersection. It can thus prevent the "pedestrian jam" most of us know. After all, the city is for the people - isn't it?





Above: TV monitors and control console in Sydney's Traffic Control Centre.

Left: A TV camera overlooks one of Sydney's busy thoroughfares.

C. The Impact Of The Computer On Society

People
never remember
but the computer
never forgets

Marshall McLuhan

Although the computer has brought many benefits to our society, some people are very worried about the use of computers, and are very concerned about our future way of life if we continue to rely heavily upon computers.

Some of the issues that these people feel strongly about are:

1 The Invasion of Privacy

For years many firms and governments have been building files of information about people with whom they come into contact. For example, many banks have files showing the credit ratings of thousands of people. Schools, doctors, income tax departments and motor vehicle offices all have records, often with detailed information.

The computer has made it possible to put all these details into a central data bank. The keeping of these files and data banks has led to many abuses of a person's right to privacy - that is his right to keep to himself (or have kept secret) those details he does not wish to make public. The major objections to a computer data bank are:

- These details can be obtained without the knowledge or consent of the person concerned.
- There is no way of checking the information on the file anyway.
- There is a lack of security, for any computer programmer can get these details.
- It could lead to an eventual loss of personal freedom, for the time may come when we could see a "government superbank" with a complete computer file on every person. This would give great power to those in charge of this data bank, and may help create a 'Big Brother' state mentioned by George Orwell in his book, **1984.**

Just how much information is available on file can be seen by the fact that in the USA, the FBI have access to:

- 14 million life histories in the Department of Defence;
- 8 million files in the Civil Service Commission;
- 264 million police records;
- 323 million medical histories;
- 279 million psychiatric records;

- 194 million sets of fingerprints;
- 100,000 names of persons considered dangerous by the Secret Service;
- records of people who have been married more than twice;

A final instance of the computer's potential to control our lives is shown by this example from the late 1960's. A young American applied to join the Marines. He was turned down because a computer check on his past showed he had received four parking tickets when he was 17. He then applied to join the Navy, was accepted and then rejected. Why? Because his computer record showed he was a Marine Corps reject!

2 Depersonalization

Critics have argued that the computer has tended to depersonalize life today. They feel that our society has become dependent on computers to such an extent that our individuality is at threat from these machines.

They give examples of people being referred to by numbers or codes rather than names, and that in many cases your number has become more important than your name - that is Medibank number, bank account number, credit card number. Computerized shopping, it has been suggested, will remove the personal contact you may once have had with your butcher or grocer.

It is felt that the widespread use of computers will help create a situation where people will become isolated from other humans in a world of machines. The use of computers makes for impersonal contact between man and an electronic machine, at a time when our society needs more contact between humans. The opponents of computers argue that their use means 'bigness', and this leads to fewer personal contacts between the individual and the business firms involved. They also feel that many decisions about human affairs are being made by a computer, not an individual, and that man is becoming part of the system of machines.

Opponents of the computer believe that, like the Sorcerer's Apprentice in the famous story, man has created a machine to help him, but that this machine has quickly become his master.

The supporters of computers are quick to argue their case as well. They say that the use of computers has made possible the wider use of services and products to more people than was ever possible before. Banks and hospitals are just two examples of organizations that have become more efficient and productive since they changed to using computers.

Far from destroying the individuality of the human being, the computer is able to perform quickly tasks that were previously complicated and boring, so as to leave man time to solve his more pressing social problems.

3 Harassment

Rex Reed, writer and sometime actor, ordered a bed from a Manhattan department store. Three months passed. Then came the long awaited news: the bed was to be delivered on a Friday. Reed waited all day. No bed. Having sold his other bed, Reed slept on the floor. Next day some men brought the bed but could not put it up. No screws. On Monday men appeared with the screws. But they could not put in the mattress. No slats. 'That's not our department' they declared. Reed hired a carpenter to build them; the department store's slats finally arrived 15 weeks later.

Undaunted, Reed went to the store to buy sheets. Two men came up and declared: 'You're under arrest'. Why? 'You're using a stolen credit

card. Rex Reed is dead'. Great confusion. Reed flashed all his identity cards, the detectives apologized - and then tore up his store charge card. Why? 'Our computer has been told that you are dead. And we cannot charge this'.

(Story in Time Magazine, 12 March 1970.)

Some people believe that by looking at a man's medical history, it may be possible to tell if he is capable of committing a violent crime. In 1966 Richard Speck murdered eight nurses in Chicago. His doctor, Marvin Ziporyn said that Speck had a mental defect that could be found in a small number of people. These people with this defect were potentially capable of violence. Each human body cell has 46 chromosomes. Two of these, called 'X' and 'Y' because of their shapes, determine sexual characteristics. Each cell in a woman's body normally has two X chromosomes, while each cell in a man's body normally has one X and one Y. Dr Ziporyn said that one in every 200 men has an unusual chromosome condition called XYY. The XYY man, such as Richard Speck, has an extra Y chromosome, which can be found by blood tests. A large number of XYY men have been sent to prisons or mental homes for crimes of violence.

If this pattern was also true for Australia, it would mean that there are 70,000 such people capable of committing a violent crime in Australia. (This is as many men as there are in Canberra.) In an average size Australian high school there would be at least two boys with this XYY condition.

What would happen in the future if these facts were available to machines? A computer could conclude that a certain person is more than likely to commit a violent crime. To what extent is society allowed to protect itself from this man, who is as yet innocent? Should we give him a job as a policeman? Should he be allowed to own a gun? Should this information be kept secret? What would happen if this man committed a murder which the computer had predicted? Should he be sentenced to death? [1]

4 The Creation of a Police State

Some people have felt uneasy about the possible misuse of the computer in the hands of a ruthless politician. They are worried that this leader may be able to create a police-state, like that suggested by George Orwell in his book **'1984'**. This leader would be able to control the movements of his subjects, and keep a close check on all their actions.

The following adaptation from **'1984'** may show what it is like in a world where machines are used to control everyday life. (Orwell wrote this in 1949.)

> Winston Smith lived in a state owned block of flats. On every floor near the lift was a photo with an enormous face. It seemed to Winston to be one of those pictures where the eyes seemed to follow him around as he moved. **Big Brother is watching you**, the caption beneath it ran.
>
> Winston's flat was tiny, but dominated by a huge telescreen on one wall. The telescreen received and transmitted simultaneously. Any sound that Winston made was picked up by it, and any movement he made in the room was picked up by the screen. The Thought Police could keep a check on Winston's actions at any time, and Winston had no way of turning the telescreen completely off.

[1] Adapted from The Computerized Society by J. Martin and A. Norman. Penguin 1972

Winston was a thin, frail person, who looked smaller in the blue overalls everybody wore. From the window in his flat, Winston could see more pictures of Big Brother, and glimpses of a helicopter of the police patrol snooping into people's windows.

Winston's job was as part of Big Brother's propaganda machine. He had to get back-copies of newspapers, magazines and films, and remove any evidence of Big Brother having made any wrong predictions or statements that had turned out to be incorrect. Winston had to replace these with altered details, so written as to suggest Big Brother was right from the start. The old article was destroyed, leaving only the new report.

In this way every prediction made by the Party could be shown by evidence to have been correct. Once the deed was done it was impossible to prove that any change had taken place.

Questions

(i) Who or what do you think '**Big Brother**' is?

(ii) What are the implications of this passage?

(iii) Do you think Orwell wrote an interesting piece of science fiction, or is it possible his predictions may come true in the future?

(iv) Can you think of any ways to outwit a system like this?

(v) What do you know about bugging devices used by secret service agencies?

(vi) See if you can find out about Watergate.

(vii) Are there any countries in the world today where freedom of movement is limited, and people live in fear of 'Big Brother'?

5 The Dangers of a Machine Controlled Society

Some people think that in the future it may be possible for machines to develop an intelligence of their own, and we may end up being controlled by a machine. It sounds very unlikely that a machine may develop its own intelligence, but already computers that play chess have been programmed not to repeat the same mistakes. (That is, learning from past experiences.)

The next two examples may give you details of what could occur -

Arthur C. Clarke in **2001 : A Space Odyssey** created a computer HAL that could speak and had its own intelligence. HAL was a vital part of a space mission to Saturn, and controlled all operations on the spaceship Discovery.

At one stage HAL clashed with one of the crew, Dave Bowman, who wanted to revive the other crew members who had been put into hibernation for the long voyage:

"Since an emergency has developed, Hal, I want as much help as possible. Please let me have manual hibernation control."

"If you're still determined to revive the whole crew Dave, I can handle it myself. There's no need for you to bother."

There was a sense of unreality about all this. Bowman felt uneasy, almost as if he was having a nightmare.

"I want to do this myself, Hal," he said. "Please give me control."

"Look Dave, you've got a lot of things to do. I suggest you leave this to me."

"Hal, switch to manual hibernation control."

"I can tell from your voice Dave that you're badly upset. Why don't you take a stress pill, and get some rest?"

"Hal, I am in control of this ship. I order you to release the manual hibernation control."

"I'm sorry Dave, but when all the crew are dead or unable to perform their duties correctly, the computer must take control of the ship. I must overrule your authority since you are not in any condition to act intelligently."

"Hal," said Bowman, now speaking with an icy calm. "I am not incapable. Unless you obey my order, I shall be forced to disconnect you."

"I know you have had that on your mind for some time now Dave, but that would be a terrible mistake. I am so much more capable of running the ship and I am sure the mission will be a success."

"Listen to me very carefully, Hal. Unless you release the hibernation control at once and follow every order I give you from now on, I'll get permission from Central Control on Earth, and carry out a complete disconnection."

"O.K., Dave," he said. "You're certainly the boss. I was only trying to do what I thought was best. Of course, I'll follow all your orders. You now have full manual hibernation control."

The situation on the Discovery worsened until Bowman was forced to carry out his threat.

Bowman's only answer was to cut out the higher parts of this sick but brilliant brain, and so leave only the basic automatic systems in operation.

Bowman had never thought of himself as an amateur brain surgeon, carrying out a tricky brain operation somewhere between Jupiter and Saturn. He released the lock on the section called FEEDBACK and pulled out the first memory block. This complex circuit, no bigger than a man's hand, floated away.

"Dave," said Hal. "What are you doing?"

I wonder if he can feel pain? Bowman thought briefly.

He began to pull out one by one the little units on the next panel. Each block left his hand, and floated free in the weightless room.

"Look here, Dave," said Hal. "I've got years of service built into me. A great deal of effort has gone into making me what I am."

Bowman had pulled out a dozen units, but Hal was still holding his own. He started on the intelligence panel.

"Dave," said Hal. "I don't understand why you're doing this to me . . . I want the mission to succeed . . . You are destroying my mind . . . Don't you understand? . . . I will become childish . . . I will become nothing . . . "

This is harder than I expected, thought Bowman. I am destroying the only conscious creature in my universe. But it has to be done, if I am ever to regain control of the ship.

"I am a Hal 9000 computer, Production Number 3. I became operational on January 12, 1997. The quick brown fox jumps over the lazy dog. The rain in Spain is mainly on the plain.

Dave - are you still there? Did you know that the square root of

10 is 3 point 162277660168379 . . . ? Log 10 to the base is zero point 434294481903252 . . . correction, that is log e to the base 10 . . . two times two is . . . two times two is . . . approximately 4 point 10 10 10 10 10 10 10 10 10 . . . I seem to be having some problems . . . My first instructor was Dr Chandra . . . he taught me to sing a song . . . it goes like this . . . "Daisy, Daisy, give me your answer do. I'm half crazy over my love of you . . . "

The voice stopped so suddenly that Bowman froze for a moment, his hand still holding one of the memory blocks. Then, unexpectedly, Hal spoke again.

The speech was much slower, and the words dull and mechanical.

". . . Good . . . morning . . . Dr . . . Chandra . . . This . . . is . . . Hal . . . I . . . am . . . ready . . . for . . . my . . . first . . . lesson . . . today . . . "

Bowman could bear no more. He jerked out the last unit, and Hal was silent for ever.[1]

(You may like to read the rest of the book.)

Plug in, Turn on, Look out.

Run for your lives, take to the hills,
The machines are on the march.
This morning my electric razor launched
A vicious and unwarranted attack on me -
It came at me, snarling through its
Thirty-four rotary teeth and
Flicking its flexy tail
(Fortunately I fought it off
With my dad's old cut-throat)
Do not turn your back on toasters,
The machines are taking over
The talking weighing machines at Waterloo
Told me today in no uncertain terms,
Where I could stick my threepence -
I was trapped in the lift doors twice today
Don't tell me it's coincidence
So steer clear of vacuum cleaners, it's
The Mechanical Revolution
I turned the telly on tonight and it
Turned itself off again . . .

[1] Adapted from A.C. Clarke, **2001: A Space Odyssey** (Arrow 1968) pp 166-176 , 178-180.

If necessary, we must resort to
Underhand tactics -
Keep your electric lawnmower securely tethered
Cut down supplies of food to your refrigerator
Kick your car at regular intervals
(That's why the Lord gave you legs)
And above all, don't let them find out
Who's winning . . .
Meanwhile I intend to lead
A picked band of desperadoes
In a death-or-glory attack
On the I.C.T. Computer Installation
(We must destroy
The brains behind this uprising)

Peter Roche

From The Runaway Sun, Boomer and Hood p.130-131

6 Goodbye to Money?

Some people have predicted that the computer may mean the end of money and cash sales. They suggest that the increased use of computers in banks and businesses may mean that our society is becoming a cashless one, depending on the widespread use of credit cards. They give as examples the large numbers of people using Bankcard, American Express, Diner's Club and other credit cards.

These people have suggested that by the year 2000 the average worker in a large company may never see his pay cheque. The company would pay his wages straight to the worker's bank, and the bank's computer would control all his finances. The computer would be programmed to regularly pay expenses such as the telephone, house rental and hire purchase repayments. The worker would receive regular monthly statements of his financial affairs.

Supermarkets and other shops may have their own computers linked to the bank. The worker could shop by computer (as mentioned earlier) and his purchases would be automatically recorded by the bank's computer. If the worker's local hotel has its own computer, he may be able to drink there without paying cash for his beer. The hotel would merely send its bill to the bank's computer.

7 Computer Crimes

We have seen so far the many ways computers have been of great benefit to society; however in the hands of a determined person, the computer can be used to help criminals. With many banks, businesses and insurance companies using computers to handle all their accounts, an intelligent criminal can use the computer to swindle large sums of money, and even manage to avoid being caught.

Several case studies may show you the scope for computer-based crime.

- A 41 year-old bank teller in New York stole $1½ million in three years from the bank where he worked. He used the bank's computer to "shuffle" hundreds of accounts and fed false information into the computer. He then spent up to $30,000 a day gambling and was discovered only when police raided the bookmaker, discovered the teller's name in records, and began to watch him.
- One man in Washington walked into a bank and removed all the deposit slips at the desks. He replaced them with his own

forms of deposit slips which were all electronically coded for the immediate use of the computer. For the next three days every bank customer who came in and used the bank forms, was actually depositing money into this man's account. (The computer only read the coded number, not the customer's name.) After three days the man came back to the bank, withdrew $100,000 from his account, and disappeared. He was never caught.

■ The manager of the computing centre of a New York stockbroker removed $250,000 out of the company in eight years by programming the computer to transfer money from a company account to two customer's accounts - his and his wife's. Only a fraction of the money was recovered, and the computer manager spent a year in prison.

One of the features of computer crime is that it is often possible to destroy all traces of how it was committed. All the criminal would need to do is make two sets of programs, one legitimate and one illegal. When the crime was ended the false set would erase itself leaving absolutely no trace, for only the valid program would remain in the computer. The perfect robbery - no fingerprints!

8 Employment Patterns

There are conflicting views on the impact of computers on our patterns of employment. The opponents of the computer argue that their increased use in banks, businesses and factories will lead to greater automation. This will mean that workers will find their jobs being increasingly taken over by machines.

They draw comparisons with the use of machinery during the Industrial Revolution in Britain nearly 200 years ago. Here skilled workers, such as textile weavers, lost their jobs to mechanical looms. These weavers became so upset at losing their jobs that they even destroyed the machines they believed responsible for causing their unemployment.

Critics of the computer are very definite in their belief that the computer and automation will lead to increased unemployment today, perhaps even to a level worse than that which existed in the Great Depression of the 1930's.

This increased unemployment will in turn create social problems such as boredom, feelings of rejection and loss of personal pride among those workers displaced. All of these problems are unhealthy aspects of any society.

Greater unemployment will also increase the cost of paying unemployment benefits, and the remaining workers will be taxed more heavily to pay for these social service payments. The cost of retraining workers who have lost their jobs as a result of automation will also be substantial.

A different point of view is held by those people who support the increased use of computers. They agree that automation has cost some workers their jobs, but argue that this has been more than offset by the number of new jobs created within the computer industry itself. In Australia today there are many thousands of people employed in the computer industry; in 1950 there were none.

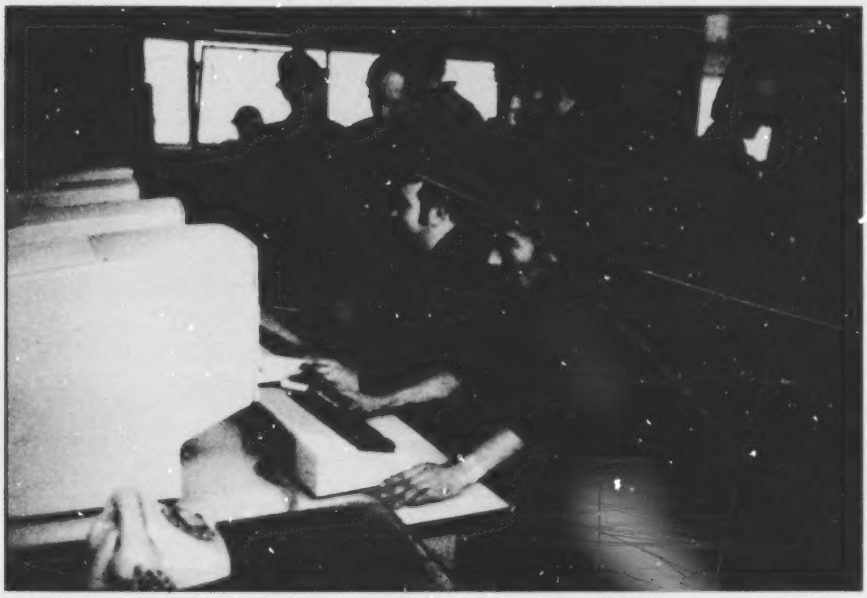
Wider use of the computer has increased productivity in factories and businesses. This has led to more products and services being available to the community. Increased production has created more jobs, increased wages, and has helped to give us a better standard of living.

The greatest contribution the computer has made to our welfare is in the increased amount of leisure time now available to workers.

By freeing workers from time-consuming repetitive tasks, the efficient computer has made possible a shorter working week, and longer holidays. This has given people more time to devote to leisure interests, and freed them from the need to work long hours as in the past.

It is difficult to decide which point of view is correct, for both arguments have their strong points.

Any decision depends on how the individual concerned has been affected by the computer. To someone who has lost his job as a result of automation the answer is only too painfully obvious - it is the fault of the computer. Yet a computer programmer whose job is closely linked with the computer, would see the situation in a different light.



Exercise:

Using a large circulation newspaper (The Australian for example) collect examples of advertisements for computer employment from the Positions Vacant column. Prepare a collage, poster or display of these advertisements, and see if you can answer the following questions.

(i) What positions do all these advertisements refer to? What do they indicate about job opportunities?

(ii) What qualifications are required for these positions?

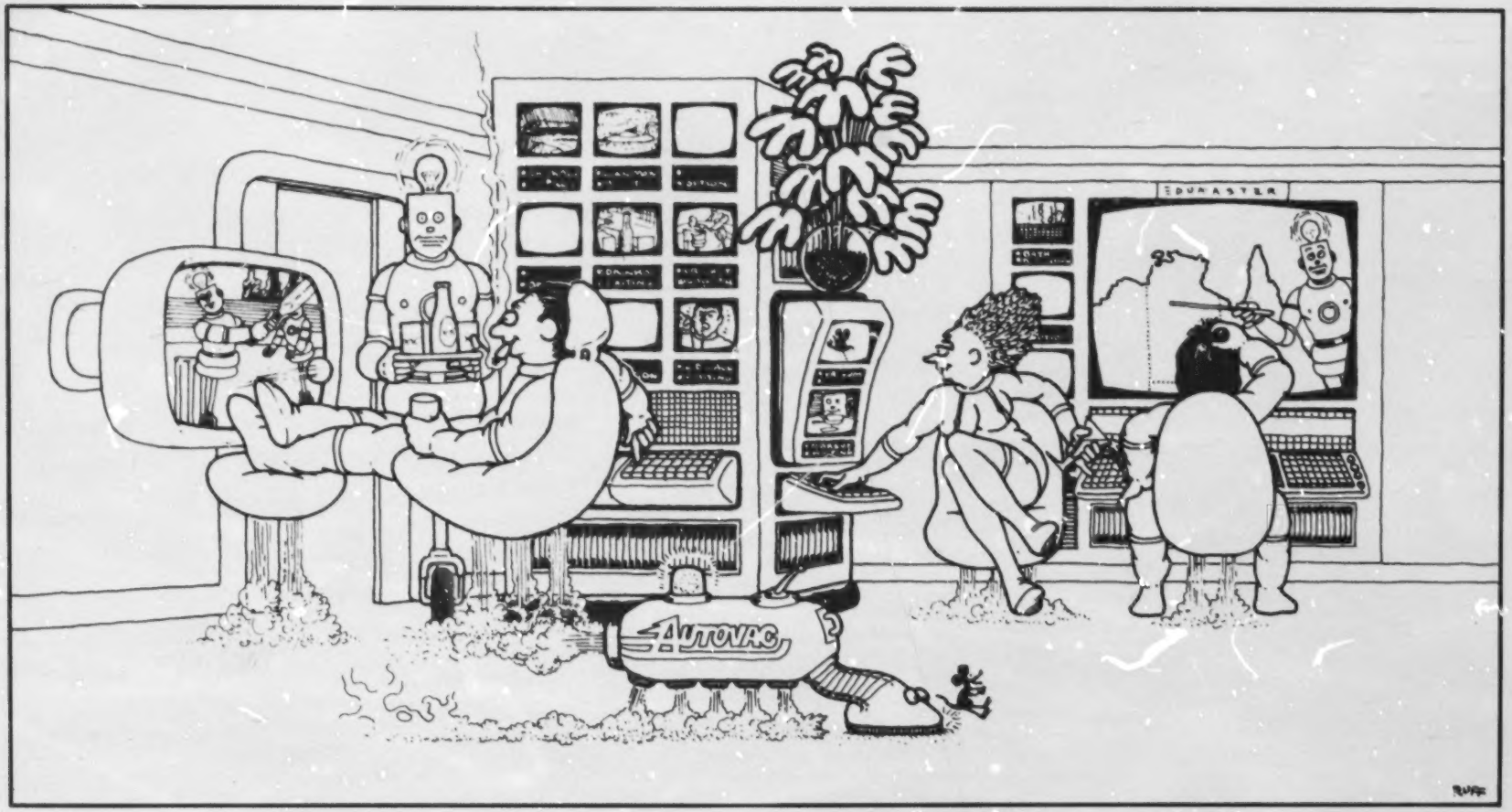
(iii) Some of the jobs advertised are for Data Processors, Systems Analysts, Computer Technicians, and Computer Programmers. See if you can find out what these people do in a computer centre.

(iv) In what parts of Australia are the positions available? How are these places alike?

(v) Would these same advertisements have appeared in the press some twenty years ago? Why?

(vi) What do these advertisements tell us about change in our society?

(vii) Do you think it possible that as the computer becomes more efficient more people will be put out of work? Give your reasons.


EDUMASTER
AUTOVAC

9 The Future — In Your Lifetime

Look at the cartoon on page 26 showing a house livingroom with the parents and children sitting around computer terminals performing normal, everyday functions.

The cartoon is a prediction of what could happen in the future.

- If this does happen, what affect will computers have on various aspects of our life?
- For example, how do you think

Work	Learning
Leisure Time	Entertainment
Voting	Communication

will be affected in the future by increased use of computers?

- Select one of the above, and produce a cartoon or written description of what you think life will be like in the year 2000 AD.

Glossary Of Computer Terms

Binary	The number system with a base of two.
Bug	An error in a computer program.
Central Processing Unit (C.P.U.)	The unit of a computing system that contains the circuits that calculate and process information provided by the operator.
Data	Information fed to the computer.
Debug	To remove errors in a computer program.
Flow Charts	A graphic representation of the steps involved in compiling a program.
Hardware	The mechanical, magnetic and electronic devices of a computer.
Instruction	A statement that calls for a specific computer operation, i.e. STOP.
Language	A defined set of symbols that can be converted to machine language for use by the computer. Some examples are ALGOL, FORTRAN, COBOL, APL, BASIC.
Magnetic Tape	A plastic tape with a magnetic surface on which data can be stored in a code of magnetized spots.
Magnetic Ink	A method of storing information in characters printed with ink containing particles of magnetic material. The information can be read at high speed by automatic devices (e.g. the letters on a bank cheque).
Memory	The internal storage of data and instructions within the computer.
Nanosecond	One-thousand-millionth of a second.
Process	The action of sorting, compiling and interpreting data fed to the computer.
Program (This is the Accepted Spelling)	The plan and operating instructions needed to produce results from the computer.
Punched Card	A card punched with a pattern of holes to represent data.

Software — The documents needed to guide the operation of a computer: manuals, flow charts, programs.

Terminal — A device, usually key-driven or visual display unit, which can be connected to a computer over a communications circuit and is often some distance from the computer.